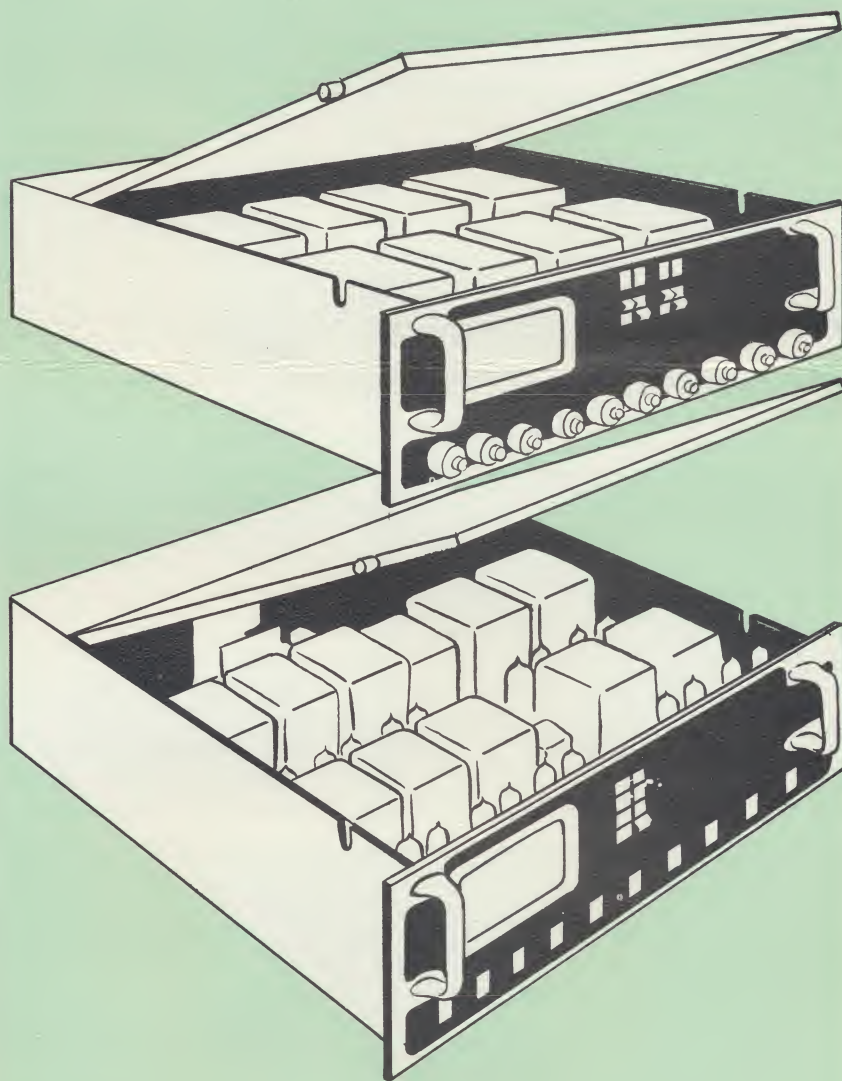


# White

INSTRUMENT  
LABORATORIES

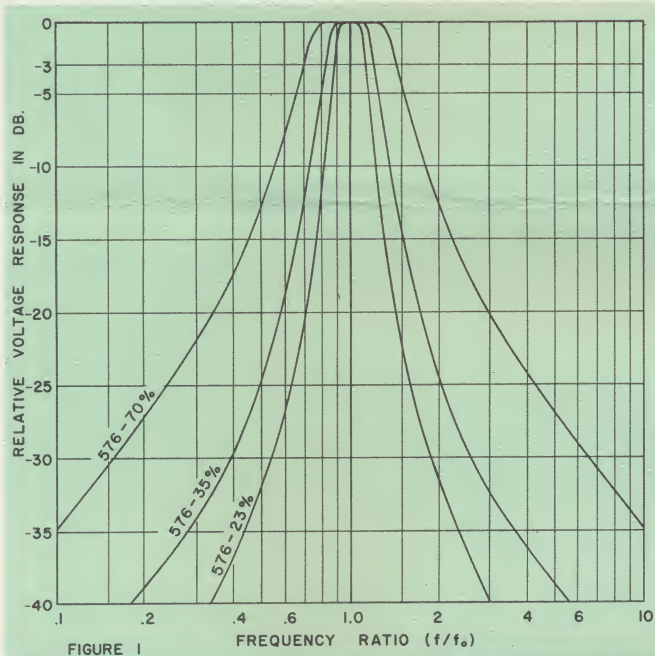
SELECT YOUR FREQUENCY PARAMETERS  
AUDIO TO FAR INFRASONIC



LOW FREQUENCY SPECTRUM ANALYZER

## A UNIQUE AND USEFUL INFRASONIC ANALYZER WHEREVER REAL TIME SPECTRUM ANALYSIS IS IMPORTANT — FEATURING ●●●

- Complete flexibility permitting immediate plug-in interchangeability of ten filters for 1 octave,  $1/3$  octave,  $1/2$  octave or other appropriate segmentation of frequency range of interest
- Prompt deliveries of 1 octave and  $1/3$  octave active filter sets from approximately 0.005 to 1000 cps
- Special modifications or frequency parameters available on fast delivery
- Passive filters compatible with active at higher frequencies
- Provision for optional prewhitening and band-limiting networks
- Choice of filtering or averaging periods
- Visual indication of operation modes for convenience
- Self-contained power supplies
- Packaged for standard rack mounting
- Simultaneous ten channel readout

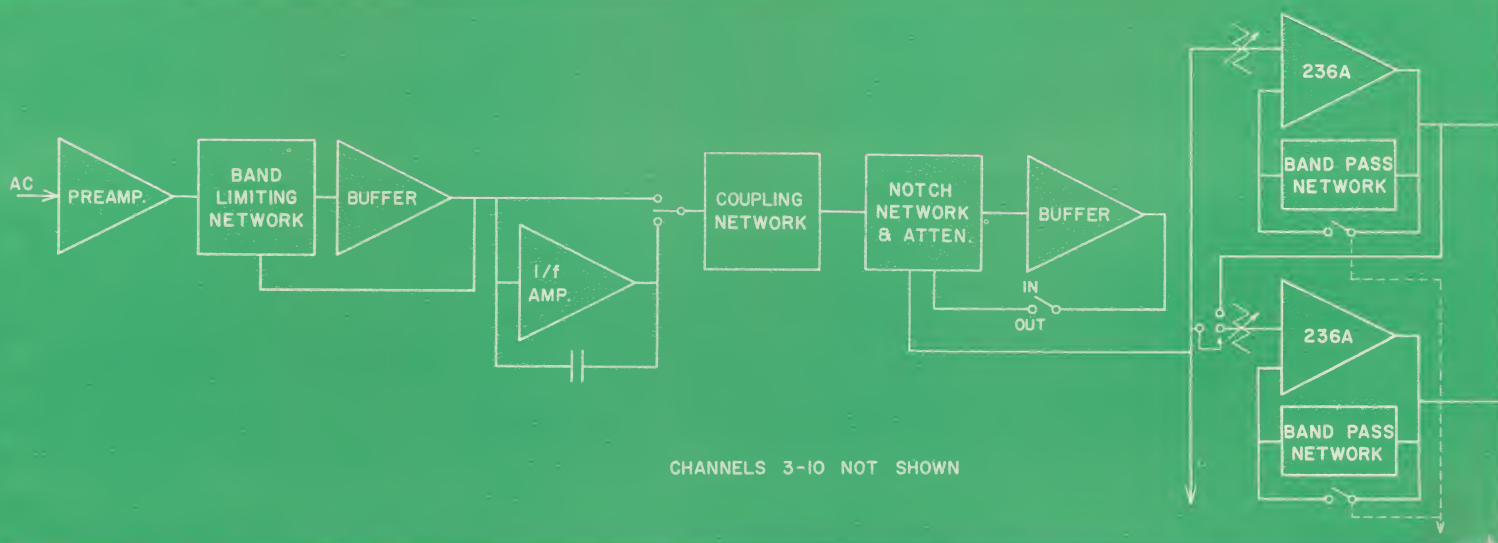


Model 110 ACTIVE FILTER MANIFOLD accepts ten filters, active or passive, in a parallel channel comb filter set for the convenience of simultaneous ten channel readout. It is recommended for use in the 0.005 cycle to 1,000 cps frequency range, and finds particular application as a fundamental component of a real time spectrum analyzer.

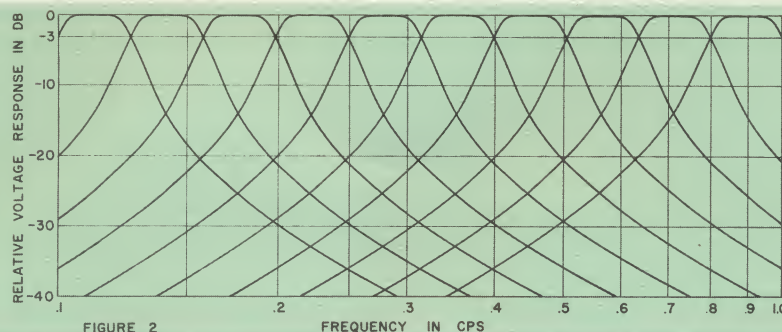
Operation of Model 110 is illustrated by the block diagram at the foot of the page. A signal is coupled directly to a feedback controlled preamplifier which raises the signal level 20 db. To prevent overloading of subsequent amplifiers from strong signals outside the band of interest, the signal is coupled through an active band-limiting network. An RC coupling network complements the band-limiting network to provide a third order maximally flat response over the entire band of interest with  $-3$  db points located approximately one octave outside (above and below) this band. For prewhitening some types of data a response shaping network may be switched into the circuit to give responses such as  $f^{-1}$  or  $f^{-1/2}$ . In a system designed to cover the frequencies from 1.0 to 10 cps the gain with the  $1/f$  response would be the same as the flat response at 3.16 cps.

An active notch network may be provided, if desired, to eliminate an interfering frequency such as 60 cps. The output of the active notch drives ten attenuators in parallel, and each attenuator controls the input of a selective amplifier. The notch network plug is used to connect the input either through the band-limiting preamplifier, through the notch network, or directly to the selective amplifiers. Notch networks having the input jumpered to the preamplifier include an attenuator adjusted for overall unity gain of the preamplifier and notch amplifier in the pass band.

Model 236A described in the separate Bulletin 216A-236A is the operational selective amplifier recommended for use in the ACTIVE FILTER MANIFOLD. Several types of feedback networks are suggested in the same bulletin for use with Model 236A. These networks may be used in the MANIFOLD, but they must be identified for this use by addition







of the letter "A" as a prefix to the standard type number for special control functions to be included. Preferred networks may be ordered from the accompanying price list or selected from special designs upon the advice of our engineering staff if special conditions exist.

The two-pole band pass response shown in Figure 1 for  $\frac{1}{3}$  octave,  $\frac{1}{2}$  octave or 1 octave filters may be obtained from a single amplifier with a Type A576 network which is a unique configuration of two twin-T's. Figure 2 illustrates the distribution over a frequency decade of ten of these units with response bandwidths set at  $\frac{1}{3}$  octave and response crossovers at the half power points. Provision is made for attenuator inputs of even numbered channels to be connected to lower adjacent channel outputs permitting cascading of two stages for synthesizing higher order response functions.

Outputs may be taken from the ten channels at this point if compatible with readout or other following instrumentation, or they may be introduced into ten input networks of the Model 120 RECTIFIER SMOOTHING MANIFOLD which is offered as a companion unit to the Model 110 ACTIVE FILTER MANIFOLD to provide a dc output voltage proportional to the average ac input voltage in each channel.

The ac signal from each channel is full wave rectified with either a Type 321 low frequency (below 100 cps) chopper ac-dc converter or a Type 322 high frequency capacitor-coupled ac-dc converter. Type 322 is designed for use between 10 cps and 20,000 cps, and is interchangeable with Type 321 in the frequency range between 10 and 100 cps.

The rectified output is smoothed with a low pass filter and may be controlled with switching functions which permit

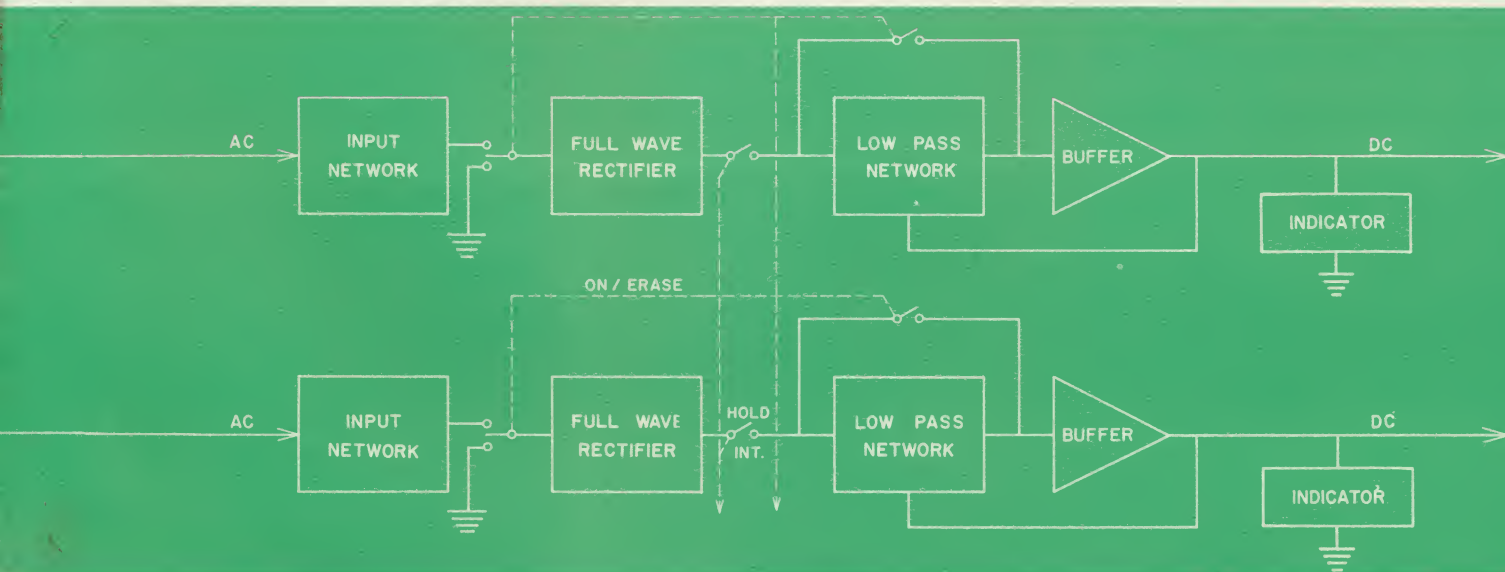
erasure of the charge from a previous signal or holding of the charge for readout. Several low pass characteristics are available depending upon the nature of the data being filtered.

If changes in signal level are important, a low pass filter which rejects the rectified ripple but follows the amplitude with minimum distortion may be desired. Type A421-( $f_0$ ) is a standard design which consists of an RC input coupling network and a third-order linear-phase active low pass network. The response characteristic of this smoothing network gives over 40 db of attenuation to the rectified signal ripple and follows the amplitude of the input with uniform delay and insignificant overshoot.

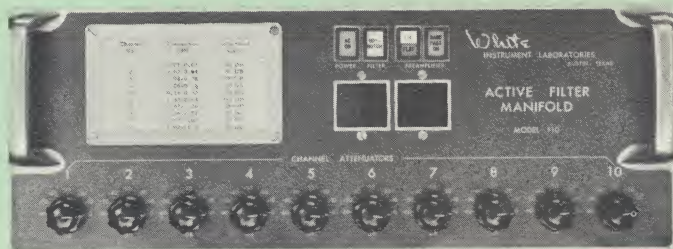
If the amplitude of the signal changes slowly, as from a narrow band filter in the Model 110, or if it is desired to average over several cycles of the input signal, a low pass network such as Type A422-( $f_0$ ) which has a long time constant may be preferred. This is a standard design which consists of an RC input coupling network and a single RC smoothing network. The smoothing time constant is about ten cycles of the center frequency which attenuates the rectified ripple over 40 db.

The filtered dc is coupled to the output by a cathode follower buffer. Ten level meters graduated in db indicate the relative voltage in each channel, and an AN connector provides for the ten dc outputs to be coupled to other recording or indicating equipment. Conversion gain is 1 volt dc per volt rms sine wave, and the full scale output is 10 volts dc.

Our engineering department is available to assist in selection of time constants or averaging periods suitable for individual requirements.

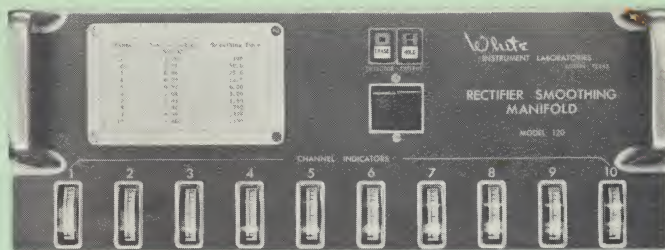






### Model 110 SPECIFICATIONS

<b>Analyzing Time:</b>	Real time operation in ten parallel channels—no data acquisition delays, no data storage problems.
<b>Frequency Range:</b>	0.005 cycle to 20 kc in ten channel plug-in sets.
<b>Filter Bandwidths:</b>	1/3 octave and 1 octave standard. Narrow bandwidths down to 1.4% offered as specials.
<b>Filter Types:</b>	Active: Ten operational amplifier plug-ins; ten channels of feedback filter networks with options of center frequencies and bandwidths. (Compatible LC filters offered at higher frequencies.)
<b>Prewhitening:</b>	Prewhitening amplifier section with plug-in options: band-limiting, notch, $f^{-1}$ , $f^{-3/2}$ and specials.
<b>Controls:</b>	Front panel gain control in each channel in 10 db steps and 10 db vernier with calibrated position at one end of the rotation. Nominal gain of 50 db available. Switch controls of prewhitening functions with color coded light indication of operating mode.
<b>Input:</b>	150k to prewhitening amplifier. Approximately 8k to gain controls.
<b>Outputs:</b>	Low impedance (cathode follower) ac outputs from each of ten channels with nominal range of 30 volts peak-to-peak.
<b>Power Supply:</b>	Internal well-regulated high voltage power supply with reserve power for Model 120. Hum balance on heater supply. Requires 110-125 volt, 60 cycle line ac source. Nominal power 100 watts. In areas of poor line voltage regulation a constant voltage transformer is recommended when measuring low frequency signals.
<b>Cooling:</b>	Fan exhausts to rear—screen protected.
<b>Dimensions:</b>	19" x 7" x 17" deep (plus 4" additional for plug clearance at rear.)
<b>Weight (net):</b>	Model 110 ACTIVE FILTER MANIFOLD without amplifier or network plug-ins — 27 pounds.
<b>Standard Accessories:</b>	Unwired mating plugs supplied with Model 110 or 120 ordered alone. Wired interconnecting cables supplied when Model 120 ordered with Model 110.
<b>Price:</b>	Please see separate price list for network prices. Manifold price is shown on page giving examples of typical pricing.



### Model 120 SPECIFICATIONS

<b>ac-dc Converters:</b>	Ten plug-in ac-dc converters with choice of two types: (1) Type 321 chopper type for frequencies below 100 cps (requires chopper drive tubes and transformer). (2) Type 322 capacitor coupled for frequencies between 10 cps and 20 kc (interchangeable with Type 321 between 10 and 100 cps).
<b>Smoothing Networks:</b>	Ten low pass filters, characteristics selected according to requirements: (1) Type A421-( $f_0$ ) consists of RC input coupling network and a third order linear phase active low pass network. Gives over 40 db attenuation to rectified signal ripple and follows amplitude of input with uniform delay and minimum overshoot. (2) Type A422-( $f_0$ ) consists of RC input coupling network and a single RC low pass network. Averages through several cycles of input signal. Smoothing time constant about ten cycles of center frequency. Attenuates rectified ripple over 40 db.
<b>Controls:</b>	Front panel function switches: erase, hold. Color coded light indication of operating mode.
<b>Outputs:</b>	Ten cathode-follower buffers couple filtered dc to output. Ten level meters indicate relative voltage in db in each channel. Conversion gain is 1 volt dc per volt rms sine wave. Full scale output is 10 volts dc. NO ADDITIONAL EQUIPMENT NEEDED FOR VISUAL READOUT. AN connector provision for coupling ten dc outputs to recording or indicating equipment.
<b>Power Supply:</b>	Internal regulated heater supply. Plate supply and line voltage derived from Model 110.
<b>Cooling:</b>	Fan exhausts to rear—screen protected.
<b>Dimensions:</b>	19" x 7" x 17" deep (plus 4" additional at rear for connector clearance).
<b>Weight:</b>	Model 120 RECTIFIER SMOOTHING MANIFOLD without network plug-ins—22 pounds.
<b>Price:</b>	Please see separate price list for network prices. Manifold price is shown on page giving examples of typical pricing.

## ORDERING INFORMATION

Model 110 ACTIVE FILTER MANIFOLD and Model 120 RECTIFIER SMOOTHING MANIFOLD may be ordered together or separately. A separate price list shows networks to be used with Model 110 and Model 120. Network prices are tabulated according to 3 db band edges for 1/3 octave (23% bandwidth) and 1 octave (70% bandwidth) responses.

Examples of typical pricing including manifolds and all networks, amplifiers, ac-dc converters and other plug-ins are given on the reverse side of the price list for networks. Ordering may take the form shown in the examples for Spectrum Analyzers and for Rectifier Smoothing Sets.

Networks having standard bandwidths of 1/3 octave and 1 octave are stocked for customer convenience in the fre-

quency range of 0.01 cycle (lower 3 db band edge of first filter of a set of ten) to 10 cps (upper 3 db band edge of tenth filter of a set ending at 10 cps). Other network types and other portions of the audio spectrum from 0.005 cycle to 20 kc will be supplied to requirements.

Our engineering staff will assist in selection of parameters suitable for the application. Deliveries of custom sets are prompt.

Manifolds, amplifiers, converters, networks and all necessary plug-ins are manufactured and distributed by WHITE INSTRUMENT LABORATORIES of Austin, Texas and carry the firm's usual one year warranty. Specifications and prices are subject to change without notice.



Mail Orders and All Correspondence to

WHITE INSTRUMENT LABORATORIES  
INCORPORATED

Box 9006, Allandale Station  
Austin, Texas 78756



# MODEL 110 AND MODEL 120 NETWORK PRICES

APRIL 10, 1964

## $\frac{1}{3}$ Octave

## 1 Octave

Frequencies to 3 db Points (cps)		Model 110 Networks (A576)	Model 120** Networks (A421-A422)
$f_1$	$f_2$	\$'s	\$'s
.0100	.0126	285	125
.0126	.0159	245	110
.0159	.0200	215	98
.0200	.0252	190	90
.0252	.0316	165	82
.0316	.0400	145	76
.0400	.0500	130	70
.0500	.0630	115	65
.0630	.0793	105	62
.0793	.1000	95	59
.100	.126	85	54
.126	.159	85	54
.159	.200	75	50
.200	.252	75	50
.252	.316	70	46
.316	.400	70	46
.400	.500	65	44
.500	.630	65	44
.630	.793	60	42
.793	1.000	55	42
1.00	1.26	50	40
1.26	1.59	50	40
1.59	2.00	50	40
2.00	2.52	50	38
2.52	3.16	50	38
3.16	4.00	50	38
4.00	5.00	50	37
5.00	6.30	50	37
6.30	7.93	50	37
7.93	10.00*	50	36

Frequencies to 3 db Points (cps)		Model 110 Networks (A576)	Model 120** Networks (A421-A422)
$f_1$	$f_2$	\$'s	\$'s
.010	.020	245	110
.020	.040	165	82
.040	.079	115	65
.079	.159	85	54
.159	.316	75	50
.316	.630	65	44
.630	1.26	55	42
1.25	2.52	50	40
2.52	5.00	50	38
5.00	10.00*	50	37

\* Above 10 cps Type A576 networks price at \$45.00 each.

\*\* Typical prices. Prices of Types A421 and A422 will vary with parameters. Ask for recommendations.

Half octave and special 3 db frequencies available.

Prices are quoted F.O.B. Austin. Terms are net 30 days.

**White**

Mail Orders and All Correspondence to

WHITE INSTRUMENT LABORATORIES  
INCORPORATED

Box 9006, Allandale Station  
Austin, Texas 78756

## EXAMPLES OF TYPICAL PRICING

### I SPECTRUM ANALYZER USING MODEL 110 ACTIVE FILTER MANIFOLD

1	Model 110 Active Filter Manifold .....	\$ 850.00
10	Model 236A Operational Amplifiers (\$27.00 each, less 5%) .....	256.50
10	Type A576 Band Pass Networks, 1 Octave each	
	0.010 cycle to 10.0 cps band .....	955.00
	Optional Networks for Pre-whitening section .....	-----*
	TOTAL .....	<u>\$2,061.50</u>

\*1/f, band limiting and notch networks will be quoted upon request.

### II RECTIFIER SMOOTHING SET USING MODEL 120 RECTIFIER SMOOTHING MANIFOLD—

For High Frequency, 10 cps or higher

1	Model 120 Rectifier Smoothing Manifold .....	\$ 600.00
10	Type 322 ac-dc Converters (\$40.00 each, less 5%) .....	380.00
10	Type A421 or A422 Coupling and Smoothing Networks,	
	1/3 Octave, 10 cps to 100 cps band .....	354.00*
	TOTAL .....	<u>\$1,334.00</u>

\*These networks price at \$350 per set of ten, 1/3 octave each, for bands at 100 cps or higher.

For Low Frequency, 0.01 cycle to 100 cps

1	Model 120 Rectifier Smoothing Manifold .....	\$ 600.00
10	Type 321 ac-dc Converters (\$50.00 each, less 5%) .....	475.00
10	Type A421 or A422 Coupling and Smoothing Networks, 1 Octave	
	each, 0.01 cps to 10 cps band .....	562.00
1	Chopper Transformer, 4 tubes .....	17.50
	TOTAL .....	<u>\$1,654.50</u>

SIMPLICITY IS COMPLEX